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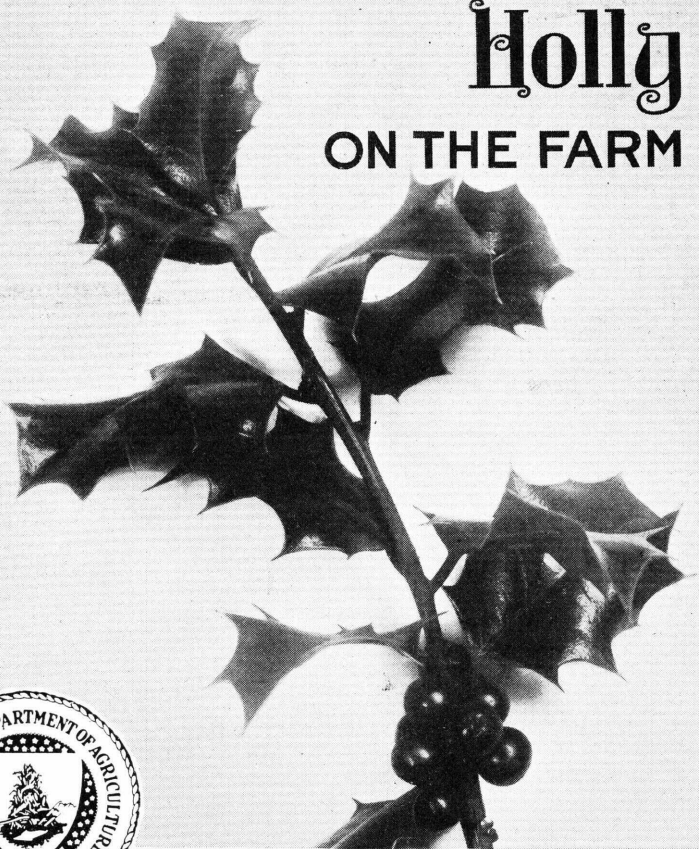
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FARMERS' BULLETIN No. 1693

Growing
Christmas
Holly
ON THE FARM



THE PRODUCTION of Christmas holly greens is a practical means of augmenting farm income in certain portions of the United States. The American and common English hollies do not grow rapidly, but normally are long-lived and capable of producing greens for a century or more if properly managed.

This bulletin describes methods of producing Christmas holly greens from the American and the English hollies and from rapid-growing varieties of the latter. The proper management of natural stands containing American holly is outlined. Practical details of the care and handling of holly seeds, culture of seedlings, vegetative propagation, transplanting, field plantings, care of plantations, and harvesting and marketing greens, are presented.

Washington, D. C.

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GROWING CHRISTMAS HOLLY ON THE FARM¹

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EVERGREEN HOLLY trees are beautiful and long-lived and are an ornamental asset to the property upon which they grow. (Fig. 1.) Growing holly for Christmas greens offers to farmers in some sections of the southeastern United States an opportunity to supplement their other farm income. There are indications that the market demand for holly has been increasing. Holly for sale may be produced from areas in which wild American holly is growing, or from planted American and English hollies.

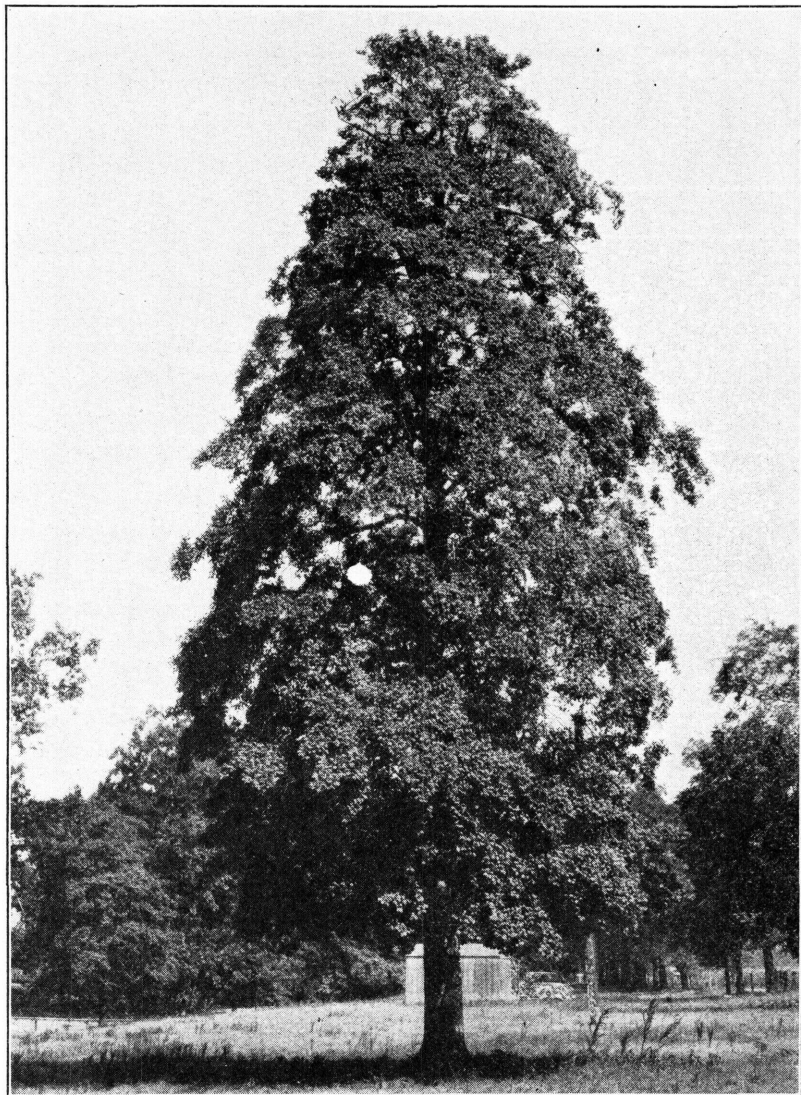
The sentiment of some organizations and persons against destructive harvesting of wild holly branches and of evergreen trees for the Christmas trade has reacted, in some sections, against cultivated material actually grown for sale. Growing cultivated holly and Christmas trees or wild holly for sale, if conservatively managed, is a legitimate business, however, and not antagonistic to the sentiment for protection of wild stock. No reasonable objection can be made to marketing holly that has been grown for sale, either under cultivation or under conservative management. There should be public recognition of the rights of those who own and manage, under proper forestry practices, the holly that has been established naturally.

CHARACTERISTICS OF AMERICAN AND ENGLISH HOLLIES

More than 300 species of *Ilex* (the holly genus) are mentioned by Rehder in his *Manual of Cultivated Trees and Shrubs*, as native to the temperate and tropical regions of both hemispheres. Probably

¹The horticultural features of this bulletin have been reviewed and approved by the Bureau of Plant Industry.

the greatest collection of different hollies is to be found at the Kew Gardens in England, where the "holly walk," planned and inaugurated in 1874, now contains some 120 species, varieties, and hybrids.



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FIGURE 1.—Magnificent specimen of a mature American holly tree which grew in Desha County, Ark., near the Mississippi River, was about 50 feet in height and 15 inches in diameter, and bore annually a full load of bright red berries

Many of the recognized hollies are garden hollies not particularly suitable for Christmas greens. Only the American holly (*Ilex opaca*), the English holly (*I. aquifolium*), and varieties and hybrids of the English holly are used for greens. The Western Washington

Experiment Station, in a mimeographed circular on the culture of Christmas holly, states that, although there are many varieties of the English holly—

only the Dutch, common English, and Select (French) English are common in the Northwest. Commercially it can not be profitable to plant any but the best trees of the Select varieties. The blue-stemmed and green-stemmed strains

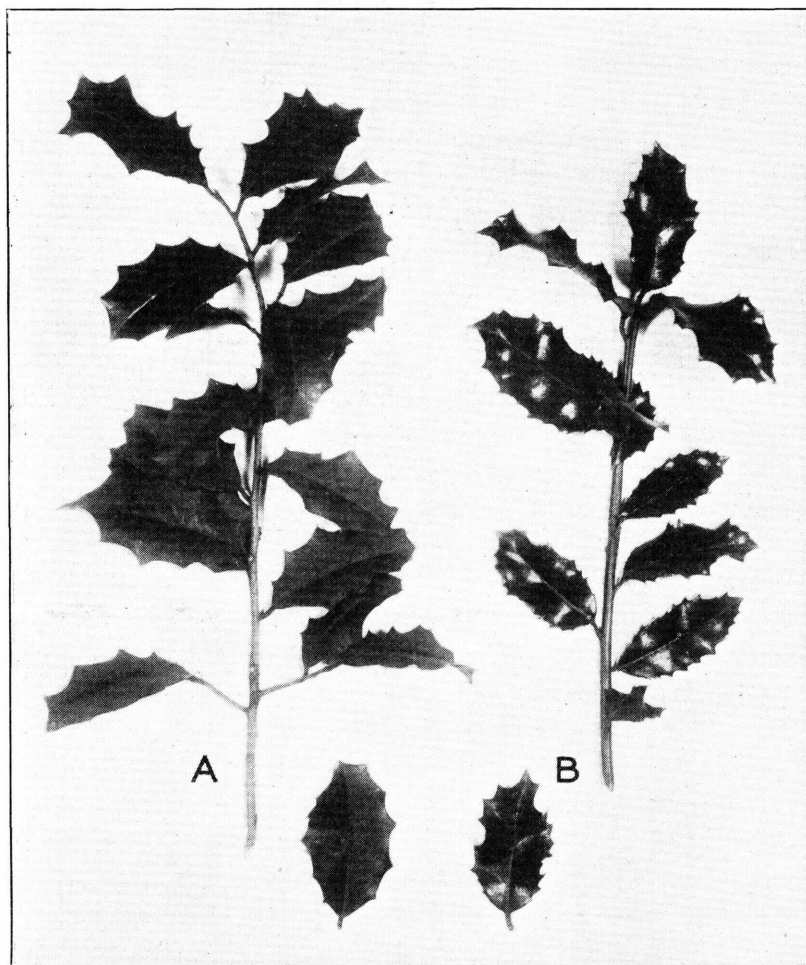


FIGURE 2.—A, Spray of American holly; B, spray of English holly

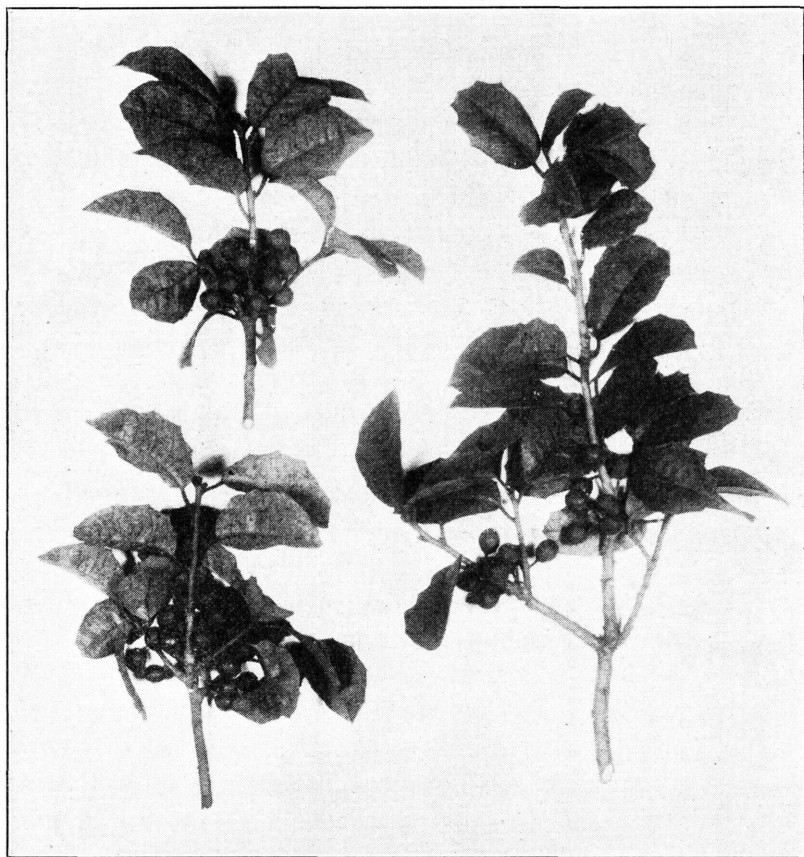
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appear to be equally desirable to the trade. The Select English trees are vigorous growers, have berries which are large and bright red, and leaves that are thick, glossy, curly, and dark green.

GENERAL APPEARANCE

The English and American holly trees have rich green leaves, usually with the characteristic prickles or teeth along the margins. (Fig. 2.) The fruiting branches bear round scarlet berries, usually

solitary on American holly (fig. 3) and clustered on English holly. (Fig. 4.) The American holly rarely reaches a height greater than 40 or 45 feet, and has spreading branches forming a narrow pyramidal head. The leaves are usually elliptical and are from 2 to 4 inches long, mostly with large remote spiny teeth, but rarely entirely without teeth. The English holly, on the other hand, reaches heights ranging from 45 to 70 feet and has short spreading branches usually forming a dense pyramidal or oblong head. The leaves are



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FIGURE 3.—Sprays of American holly showing the groups of solitary berries produced by female plants

generally ovate and are from $1\frac{1}{4}$ to $2\frac{3}{4}$ inches long. The leaf margins are wavy, with large triangular spiny teeth, which tend to disappear on old trees.²

MALE AND FEMALE TREES

The American and English hollies are diœcious; that is, the male and female flowers are commonly borne on separate trees. Berries

² Additional data on other species of *Ilex* and hollylike plants are given on p. 21.

are borne only on female trees, or on the female portions of those occasional trees which bear both male and female flowers. When seedlings are grown, it might be expected that the male and female trees would be present in about equal proportions, but this is not the case; seedlings from American and English holly seed are often in the proportion of 10 male to 1 female tree. Plants may first bear flowers at an age between 5 and 12 years; until that time the male and female plants can not be distinguished.

The fruit of the evergreen hollies is the well-known round red berry which contains from 2 to 8 (usually 4) seeds. The berries are usually one-quarter inch in diameter, but some varieties of the



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FIGURE 4.—Sprays of English holly showing the berries in clusters. Note the beauty of the stiff, glossy leaves

English holly have larger, more brilliantly colored berries that add greatly to the beauty of the sprays on which they are borne.

GROWTH RATE

The growth rate of hollies, which in general is rather slow, varies according to the fertility of the soil, the length of the growing season, and climatic conditions. The growth to be expected from wild native holly can not be foretold, since many variable factors enter into consideration. Wild growth in nearly all cases is slower than that of trees planted in the open and kept growing under the best conditions. In exceptional cases grafted trees have been known to reach a height of 6 feet in three years and to bear fruit in five years, but this rate of growth does not apply to most plantations. In the

East the best trees probably will reach 8 to 10 feet in height when the plantations are 12 to 20 years old. In some plantations of holly in the Pacific Northwest the trees have reached 15 feet in height when 20 years old.

SECTIONS ADAPTED TO HOLLY GROWING

The American holly formerly had a natural distribution from Massachusetts to Missouri and south to Florida and Texas. Destructive harvesting has practically eliminated the species in the region from Massachusetts to central New Jersey, except where it occurs on protected properties. Probably the region most favorable for growing the species commercially is from Norfolk, Va., to Florida, within 50 or 60 miles of the coast, and westward in the Gulf region to Louisiana; but a few nurseries as far north as Long Island and Massachusetts are apparently growing American holly plants successfully.

The English holly is not so hardy as the American; and though it may be successful in the southeastern United States, it is not likely to survive if planted farther north than Washington, D. C. In the northern part of this range it should not be planted in exposed situations or at very high elevations. Some sections of the Pacific Northwest offer excellent climatic conditions for the species. In the vicinity of Puget Sound the mildness and humidity of the climate are similar to those of England, and English holly or some of its variations is grown on numerous holly ranches. The species grows well in the lower Columbia River Basin, though some trees are usually frozen back during severe winters, and it is being grown in nurseries as far south as San Francisco, Calif. It is doubtful, however, that the species can be recommended for holly plantations in California.

SOIL CONDITIONS AND SITES SUITABLE FOR HOLLY GROWING

Though hollies will exist in a variety of soils, they grow best in well-drained, deep, sandy or gravelly loam soil that is fairly strongly acid or what is known as subacid. For commercial holly growing, badly drained land, though acid, should be avoided, as conditions attending poor drainage more than offset the advantages of the acidity.

In sections where damage is likely to occur from unseasonable frosts it is desirable to locate holly plantations on areas having good air drainage to avoid "frost pockets." In the Pacific Northwest holly berries and sprays seem to develop best after a damp, cool spring. For the best growth of the holly and for berry production the site should be protected from strong, drying winds, so that moisture can be conserved.

Upon some farms are small units of good soil difficult to keep in annual crops because of their isolation or for other reasons. Such locations offer opportunities for growing holly in solid plantations. Once planted to holly, such an area needs only occasional cultivation, and the fertility of the site promises better growth and subsequent returns than can be had from poor soils.

MANAGEMENT OF WOODLAND AREAS CONTAINING AMERICAN HOLLY

On many areas in the Southeastern and Gulf States native American holly grows in more or less abundance. It is a true forest species and occurs in a varying admixture with other trees. As it usually favors the moister situations and the richer soils, it is most often associated with hardwood species. The individual trees are sometimes widely scattered. As holly is relatively slow growing and somewhat tolerant of shade, the trees usually are overtopped by such species as red maple, black tupelo, and sweet gum, which, for the most part, grow more rapidly and demand more light. The competition with these associated trees and with vines often results in much slower growth of holly than would otherwise be the case, and also to a considerable extent in poor form and rather thin foliage.

Where natural holly trees are already established, particularly when they are too large for convenient transplanting, it would be better to consider whether Christmas greens can be produced more profitably by proper care of the trees already established than by moving the trees to the plantation. These trees often represent many years of growth that can be capitalized. The treatment necessary to transform these poorly formed forest hollies, and those of better quality as well, into more desirable and profitable ones is relatively simple. It involves merely giving the trees an opportunity to develop their crowns and to increase their growth rate. It would not be necessary in every case to remove all of the trees surrounding the holly, since usually the crowns of only one or two trees are casting the shade which suppresses it. Removal of these trees either by cutting or by girdling is apparently all that is called for. Where vines, chiefly grapevines, are found, they should be cut. Poorly developed and injured trees may be improved by pruning. In open woodlands, where the spacing of trees is irregular and considerable areas are unoccupied, it may often be desirable to plant wild or nursery-grown holly plants in openings so as to utilize the area more fully.

Because holly tolerates shade it bears leaves close to the ground, and many of those which drop remain close to the trunk of the tree. Since green leaves, as well as the dead ones, burn readily and the bark is easily injured by high temperatures, stands containing holly should be protected from fire. Even light fires, which not infrequently burn in the litter and underbrush in the lowland forest, often kill the whole holly tree, or at least a considerable portion of the lower branches. (Fig. 5.)

Grazing is not particularly injurious to hollies; but where small plants are present it should be restricted in order to prevent injury from trampling. In areas where livestock concentrates the packing of the soil is detrimental even to large holly trees.

Solitary holly trees will often yield enough greens to pay for their care if a good local market for small quantities of greens is available. Single holly trees can be freed from the competition of other trees in the forest and fertilizer can be worked into the soil about their bases to increase twig growth. Proper trimming of the twigs of a healthy tree will not appreciably detract from its ornamental value and may even improve it.

Without care such as has been described, native holly is not wholly satisfactory for the commercial production of holly greens. The quantity of greens that can be harvested annually from native holly is generally considerably less than the product of a comparable area of planted orchard in full bearing, but often the expense of production will be proportionately very much less. Growth conditions, however, can be improved to such an extent that holly alone will give appreciable returns on woodland areas where it occurs, and the improvement can be combined with the management, for timber production, of the other forest species that may be present.

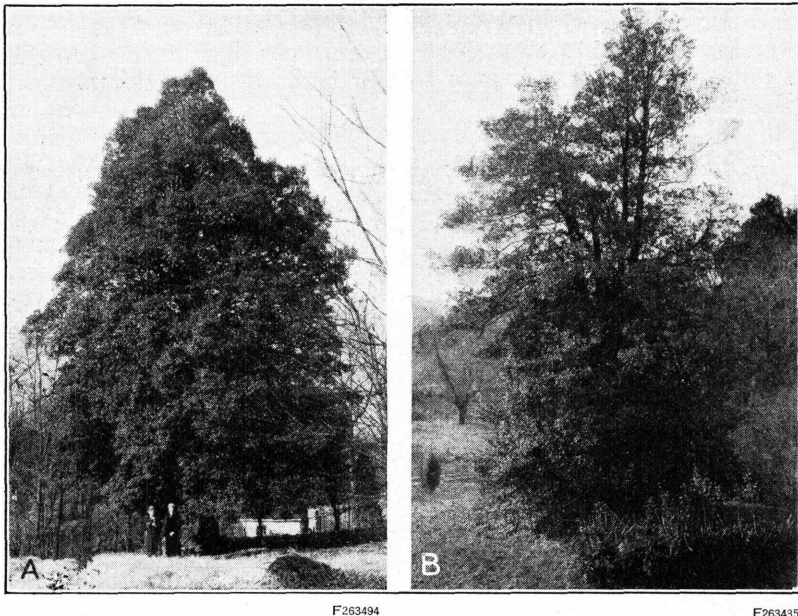


FIGURE 5.—Two American holly trees on an old Virginia estate. The trees stand about 75 feet apart and may have been planted before 1785, at which time the near-by house is known to have been in existence; A, A beautiful specimen about 45 feet tall and with a trunk $1\frac{1}{2}$ feet in diameter; B, the deleterious effect of fire on holly. Heat from a near-by brush fire killed the lower limbs of this tree and caused root suckers and sprouts to develop and form the rounded mass of foliage at the base of the tree

OBTAINING HOLLY STOCK FOR PLANTING

WILD SEEDLING STOCK

In the southeastern and southern sections of the country small natural holly plants may occur in sufficient numbers to be used as transplanting or field-planting stock. Disadvantages of such wild stock include its great variation in age and size and the fact that many of the plants, though small, have developed such an extensive root system that many roots are lost in digging. An advantage, on the other hand, is that these plants may often be obtained for little or nothing other than the cost of digging and transportation. In general, wild seedlings will not prove very satisfactory for transplanting.

REPRODUCTION FROM SEED

Clean, dry holly seed can be bought from many seed dealers, at prices varying from year to year, or it can be collected by the grower. The seed is obtainable in the late autumn. Berries collected for seed should be taken only from vigorous, healthy trees. The seed should be separated from the pulpy portion by macerating the berries in water, after they have been gently crushed, until the seed is washed and freed from the pulp. The good seeds will sink in the water and can be collected.

Germination of seeds of the English and American hollies is very slow, usually extending over one year at least.

A seed bed should not be destroyed because no seedlings, or only a few, appear during the first season; many seeds do not germinate until the second, or even the third season after being planted.³

Holly seed can be planted at any time. However, little is gained by fall or winter sowing, as the seed usually does not germinate for a full year afterwards. Seeds sown in May have been found to germinate the following spring (a year later) in the same proportion as those planted six months earlier. Since so little is gained by fall planting, it is often desirable to hold the seed over for the spring planting, and for this purpose the seed may be stratified. It is not at all certain that stratification aids germination, but it is a satisfactory way to keep the seed moist, cool, and safe from molestation. For stratifying seeds, use a sound wooden box in the bottom of which two to four small drainage holes have been bored. Spread moist, clean sand an inch or two deep over the bottom, and on this place a thin layer of seed. Moist sand and seeds are then deposited in alternate layers. The box should be buried in soil in a well-drained, shaded spot out of doors and left until the seed is wanted for planting in the spring, at which time it is recovered by sifting the contents of the box through a screen or sieve of such a mesh that the sand is passed and the seeds retained.

Seeds may be sown in seed beds as soon as they are collected and cleaned, if the beds are protected from molestation. The irregularity of seed germination makes impracticable any statement as to the best density at which to seed beds. The ability of the seed to germinate, its size, and the number of seeds per pound will vary from year to year. One lot of dry clean seed of *Ilex aquifolium* contained 5,600 seeds per pound, about 5 per cent of which were obviously infertile.

Seed may be sown broadcast or in rows, in well-prepared soil. It should be sown rather sparsely and covered with not more than half an inch of soil. For the first two years seedlings seem to do best under partial shade, such as occurs on the north side of a building or hedgerow, or under a low frame to which parallel laths, spaced an inch apart, have been nailed. To conserve soil moisture it is well to cover the seed bed with an inch of compost or thoroughly rotted manure (as free as possible of ammonia), which has been finely divided and freed of lumps.

³ Though it has been stated that germination may be hastened by placing seeds in a 5 per cent sugar solution and putting them under heavy pressure, such a method is not generally practicable because of the cost of the necessary equipment and experimentation. Treatments with boiling water, sulphuric acid, and caustic compounds have been tried but have not proved very successful.

Seed beds do not demand a great deal of attention but should be protected and kept free of weeds and grass. During dry periods they should be watered. After one or, at the most, two years, the plants do not appear to need shade.

VEGETATIVE PROPAGATION

Holly may be propagated by means of cuttings, layering, or grafting. Propagation by layers or cuttings has a distinct advantage over reproduction by seed. Plants resulting from cuttings or other vegetative means of reproduction run true to type, that is, they have the characteristics of the plants from which the cuttings came. A



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FIGURE 6.—Rooted cuttings of English holly 1½ years old. The three cuttings on the right are from "berried" stock

plant developed from a cutting, scion, bud, or layer of a female or berried plant or branch can, therefore, be counted upon to produce berries and to have the leaf and other characteristics of the parent. The grower can thus favor the propagation of female trees, whereas by seed reproduction a preponderance of male trees is grown. (Fig. 6.)

If maximum returns are to be obtained from plantations, particularly of select English holly, it is essential that the most vigorous, attractive, and rapid-growing stock be obtained. Uniform stock of this character can be reproduced only by vegetative propagation, details of which are given in Farmers' Bulletin 1567, Propagation of Trees and Shrubs.

LAYERING

The method of propagation known as layering is rather cumbersome where large numbers of plants are desired, and requires considerable ground space. In this process a stem of an established plant is bent down to earth and a portion of it covered with soil, but the tip of the branch is left exposed. Roots develop from the buried

portion. A small cut, one-third or more of the way through the underside of the stem where it is buried, usually encourages the development of roots. When well-established new shoots and roots have developed (usually by the end of a year), these new shoots, complete with their roots, can be severed from the parent stem. The new plant should, however, be left in place in the soil for another year before it is transplanted. This method is used for reproducing English holly and some of its varieties in the Pacific Northwest.

CUTTINGS

Propagating holly by cuttings has not been universally successful,^{3a} and it is not recommended that the inexperienced person attempt to use this method extensively without first experimenting with it. Experiments carried out by P. L. Ricker (Wild Flower Preservation Society and United States Department of Agriculture cooperating) and others, and a report by Zimmerman and Hitchcock⁴ suggest the following facts that should prove helpful in propagating hollies by means of cuttings:

A medium of one-half sand and one-half peat moss by volume, or 3 inches of sand over 1 inch of sphagnum moss, is good for holly cuttings (indicating that hollies need acid soil).

Cuttings of evergreen hollies usually will not root when all the leaves are removed.

Four to six inch cuttings of current wood only are better than those with 4 to 5 inches of current wood plus a portion (or heel) of 2-year wood, though the latter are fairly satisfactory.

Though some cuttings might root in as short a period as three weeks, most of the cuttings will not root in less than three or four months.

For most practical purposes a daily temperature range of 65° to 75° F. is satisfactory, though temperatures 10 degrees lower at night are not harmful.

Cuttings may be taken from parent stock from October to December.

Cuttings should be set firmly about 3 inches deep in the soil.

Dormant cuttings may root satisfactorily, but the buds may not develop into shoots until the rooted cuttings have been stored in a cool place for two months or more.

GRAFTING

Some nurseries prefer grafting in the spring and budding in the summer to propagating hollies by cuttings, since grafted stock raised in greenhouses or frames produces plants which reach salable size more quickly. Inasmuch as this difference in size tends to disappear after a few years, this particular reason for grafting has a value more apparent than real to the holly orchardist.

Grafting has been of greatest value in the reproduction of individual ornamental hollies, but occasional owners may desire to experiment with male trees top-worked with female fruiting scions to make these male trees bear fruit.

The common whip graft is satisfactory for grafting English holly and its varieties.

Grafting demands special experience and equipment and can not be recommended for unrestricted use by the untrained holly grower. Holly can be successfully grafted and budded, but it will pay the average owner to buy grafted stock or to hire an experienced propa-

^{3a} Much-improved rooting of cuttings of holly and other plant materials is reported through the use of plant hormones that have become available to the public in the last few years.

⁴ American Journal of Botany, volume 16: Vegetative Propagation of Holly.

gator to top-work seedling stock that has reached a suitable size in a plantation; or, preferably, to reproduce his female stock by layering.

BUDDING

Shield budding may be used to reproduce hollies but, like grafting, requires a certain skill if satisfactory results are to be obtained.

TRANSPLANTING

Transplanting of holly is considered to be difficult but should be successful in the majority of cases where the procedure outlined below is followed and the work is carefully done.

When holly plants are two years old they should be transplanted,

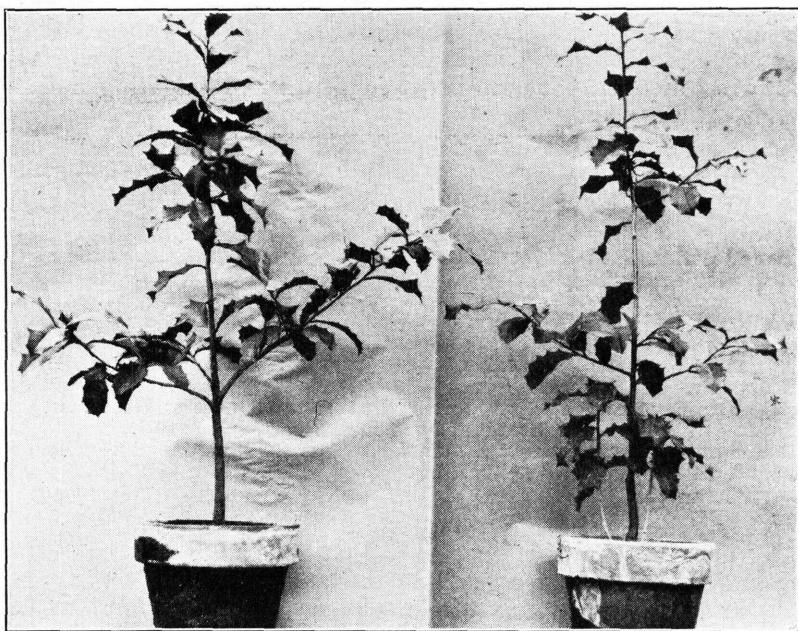


FIGURE 7.—Rooted Cuttings of American holly 4½ years old

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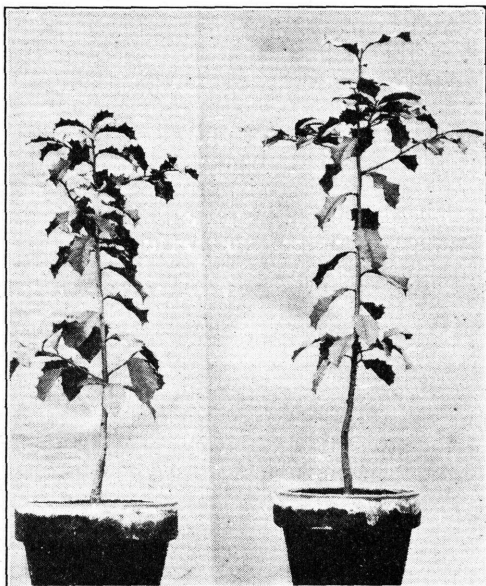
in rows, to new ground. Plants should be spaced about 1 foot apart in the rows; the distance between rows depends on the method of cultivation to be used—that is, whether it is to be done by hand, horse, or tractor. The plants, particularly if grown from seed, can remain so spaced for two or three years, after which time, if still larger plants are desired, they can be retransplanted 2 feet apart and left for two years more. Plants from vegetative propagation are often big enough to be set out in the field after the first transplanting. (Figs. 7 and 8.)

Transplanting in quantity can best be done at the end of the growing season in the fall or just before the start of growth in the spring, though it is possible to move a holly tree with a sufficient ball of dirt about the roots at almost any time. In parts of the Pacific Northwest much of the transplanting is done in October. In other sections

planting in the spring would seem preferable, though opinions differ upon this point. In the most southern tier of States transplanting may be successfully practiced at almost any time during the winter.

During transplanting the roots should not be exposed to the air long enough to dry out even partly. Exposed roots may be covered with moist soil or wet burlap, or plants for the planting crew can be kept at hand in pails containing wet sphagnum moss or leaves. Plants can also be moved with a ball of soil about the roots. Though this is a somewhat costly method, greater survival may be achieved in the final plantation.

Transplanting usually causes some injury or loss of roots and results in a check to the plant functions, placing the plant somewhat at a disadvantage in procuring moisture and nutrients from the soil, particularly if a dry period follows the transplanting. Hence, when plants are set out it is good practice to remove a few or nearly all of the leaves in order to reduce loss of moisture. Even if this is not done, there is usually a natural fall of leaves which may achieve the same end, though after some delay. If leaves of newly planted hollies shrivel but do not fall, the plants should be immediately pruned to reduce the foliage, or shaded from the sun, or both. A mulch of compost, decayed leaves, or well-rotted manure applied to the ground above the roots after transplanting is usually desirable to conserve soil moisture. During very dry periods transplants should be watered, at least for the first year or two.



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FIGURE 8.—Seedlings of American holly 4½ years old. Note the greater vigor and size of the rooted cuttings shown in Figure 7

DETAILS OF ESTABLISHING THE PLANTATION

GENERAL CONSIDERATIONS

Pure plantations of holly on open land, rather than planted in woodlands, offer a more intensive means of producing greens, and though costs of managing them are greater than for comparable areas of wild holly, the returns may be proportionately greater. Less attention is required by the holly plantation than by most field crops, and labor can be supplied at times when there is the least other farm work to be done. Improvement of woodland areas containing holly can be carried out during the winter. Planting can be done

before spring plowing. Holly greens are harvested a few weeks before the Christmas-holiday season. Part of the cultivation of some of the more intensive plantations comes during the growing season, but the exact time of cultivation is not so critical as that of field crops. Some plantations in the West may be cultivated only once a year, just after harvest time.

CULTIVATION

It is best to prepare and cultivate a site for holly as for any fruit orchard. Holly plants need very careful treatment and good conditions when first set out. After the original plowing and planting, it is not essential to cultivate more than enough to keep weeds and grass from around the newly planted trees until they are reasonably well established. Cultivating the soil naturally results in greater thriftiness and more rapid growth of the trees and consequently makes possible an earlier return from the plantation. If soil acidity must be promoted, it may be best to leave undisturbed leaf litter or a mulch of similar material about the base of the trees rather than to practice complete cultivation.

SOIL FERTILITY AND FERTILIZER

Upon soils of low fertility holly trees will usually be unable to make the good twig growth or to produce the large berries needed for the best financial returns. Removing quantities of material from the trees necessitates proper attention to soil fertility, as in any orchard, if the yield is to be kept high. Though common farm manures, commercial fertilizers, and cover crops can be adapted to holly orchards, the holly grower should ascertain the particular requirements of his land by various treatments of single trees or groups of trees for a year or two before applying a single treatment to the whole orchard.

In western Washington soil fertility and the soil's water-holding capacity are said to be in need of attention before the best growth can be obtained in holly plantations.⁵ Manures are capable of both adding fertility and improving moisture conditions. The author of the publication cited recommends a trial of various treatments, as mentioned above, and suggests the following treatments for consideration:

Manure (horse and cattle), 6 to 8 tons per acre.

Manure (chicken litter and sheep), 4 to 5 tons per acre.

Commercial fertilizer (5 per cent nitrogen, 10 per cent phosphoric acid, and 7 per cent potash or thereabouts), 1 pound per transplant or 6 pounds per mature tree, worked into the soil about the trees.

Superphosphate, 300 to 400 pounds per acre to supplement manures (often beneficial).

Cover crops (40 pounds of common vetch and 70 to 80 pounds of rye per acre, to be turned under by spring plowing).

SPACING THE TREES

The spacing adapted to the final planting of a holly orchard is determined by the species used, the factors affecting growth, and the

⁵ Western Washington Experiment Station Bulletin 7-W: The Culture of Christmas Holly.

manner in which the holly is to be clipped when it comes into bearing. Though hollies will stand an appreciable amount of shade, they should not be spaced so that they will crowd one another when they reach producing size unless some trees are to be removed by thinnings. Crowding seriously hinders harvesting of the foliage and tends to reduce the production of foliage in the lower portions of the tree in favor of the upper portions, which are not so easily reached.

Trees 3 to 7 years old may be planted with a square spacing of 20 to 25 feet each way or may be placed 15 to 20 feet apart in rows 20 to 25 feet apart. If the latter system is used, most of the foliage will be clipped when the trees get large by working down each side of a row and not by attempting to harvest much material from between the trees after the first few years. In the Northwest spacings of 25 to 27 feet each way are recommended. Small trees planted with such wide spacings as those suggested above appear unnecessarily far apart. As the trees increase in size, however, the reason for the wider spacing becomes apparent. When the maximum harvest is reached the trees will occupy almost as much of the ground as is compatible with ease of harvesting, and they will still be growing.

Small holly trees can be planted two, four, or even eight times as densely as recommended in the preceding paragraph if the owner will make adequate thinnings later on before the trees begin to crowd each other. Such thinnings will be absolutely essential for the final success of the plantation. The smaller trees removed in thinnings can often be dug up and sold as live plants or cut out and trimmed to yield the maximum amount of greens. This will bring in considerable revenue before residual trees (saved for the final stand) are large enough to withstand trimming for greens.

The number of trees per acre needed for any spacing can be determined by dividing 43,560 (number of square feet per acre) by the product of the spacing in feet in two directions; i. e., spacing 15 by 25 feet equals 375 square feet per tree or (43,560 divided by 375) 116 trees per acre.

In open woodlands holly should be so planted as to utilize as well as possible the openings that exist. Where these openings are extensive, holly can be planted with a uniform spacing; but where the openings are small, only one or a few trees should be planted in each. Holly grows so slowly when shaded that planting it under the crowns of other trees can not be recommended.

PLANTING RECOMMENDATIONS

Protect roots from injury or loss.

Prevent drying out of the roots, especially from exposure to the air, sun, and wind.

If planting is followed by a dry period, water the trees sufficiently to insure their survival. A mulch about the base of the trees is helpful in conserving moisture.

In all planting operations (and this includes transplanting) dig holes large enough to receive the roots in a natural position without cramping.

Plant female, rapid-growing, berry-producing stock when possible. Holly sprays with berries bring greater returns than sprays without berries. The holly grower should therefore strive to establish a plantation in which female or berry-producing trees greatly predominate.

SPECIAL CAUTION

Do not destroy all male trees, since individuals scattered among the female trees are needed to furnish pollen and insure development of the berries. The exact proportion of male to female trees necessary for best results can not be stated definitely, but 1 male to 10 female trees should prove satisfactory if the male trees are uniformly distributed.

It is reported by the Western Washington Experiment Station that Dutch and common English holly trees apparently mature some fruits without the introduction of pollen, but that certain select English holly trees produced practically no fruit during 1930 and 1931 unless pollen was supplied by male trees.

HARVESTING HOLLY

Harvesting may begin in 12 to 20 years if the trees appear thrifty and are well clothed with foliage. The operation may begin about December 1, or even sooner, and continue from one to two and a half weeks or more, depending upon market outlets for the material and how far it is to be shipped. Sprays cut too early will become too dry, and will be unsatisfactory, by Christmas. Though some of the younger English holly trees (20 to 25 years old) will yield as much as 35 to 40 pounds of foliage without being injured, they should not be trimmed too heavily. Trees should be left in good condition for recovery and growth. If they are not trimmed too heavily, they will increase their size and the amount of foliage more rapidly and return larger yields later.

Leaders or the actual tips of strong side branches should not be harvested or pruned from young trees, for the tip buds, which would be removed, are needed for making yearly growth in length. Cutting should be from the sides of branches and 2 or 3 inches of each twig should be left in place. This portion that remains usually has several buds which will give rise to more material the following year. When the trees are as big as is desirable, ends of main branches and leaders can be cut to keep the trees from getting larger.

Some older trees of English holly will bear fruit only in alternate years if they are allowed to become dense and to bear heavy crops of berries. The lower limbs may become too heavily shaded. Pruning, in addition to the annual trimming, is often desirable, opening up the crown a little to encourage an annual berry crop and to benefit the lower parts of the tree.

Holly branches are easily collected by spreading a canvas near the trees and dropping the sprays upon it as they are clipped, or by dropping sprays into large baskets or hampers. Such methods are essential if the ground is wet or snow covered and the sprays themselves are dry. If possible, sprays should be collected only when they are dry.

Holly must not be shipped while wet on the outside, because it will mold or sweat; this causes the leaves and berries to become discolored or to drop off. The cut sprays are therefore spread on trays to dry (drive off the external moisture), but the drying room must be kept cool.

While some cutting, thinning out of trees, and trimming that will help reduce the overhead expenses can be done in a holly orchard before it comes into real production, owners should expect to wait 12 to 20 years after planting before they will receive an appreciable financial return.

TRAFFIC IN CHRISTMAS HOLLY

In late years the center of production for American holly greens has been in the coastal portions of Delaware and Maryland, although considerable quantities of greens are produced as far south as North Carolina. The center of production is definitely moving southward, Maryland having only recently supplanted Delaware as the leading producer.

In view of this southward trend, it is well to call attention to the fact (discussed later under Shipment of Holly) that packed wreaths have been found to deteriorate or discolor in transit at temperatures of 50° F. or higher. Although branch holly is being successfully shipped from the North Carolina coast line, the production of wreaths in regions south of Maryland should be entered into with caution, since the frequent high temperatures are very likely to affect shipments in standard commercial cases.

Relatively small quantities of English holly are shipped from the Pacific Northwest. The Western Washington Experiment Station estimates that in late 1937 there were some 15,000 commercial holly trees or 220 acres planted in western Washington. Of these two-thirds were of bearing age, and one-third of nonbearing age.

It is estimated that in an average year 10,000 to 15,000 persons in the eight southern counties on the Eastern Shore of Maryland engage in harvesting holly, and obtain an annual income of \$350,000 from this source.⁶ (Fig. 9.) An entire family usually engages in the industry. Approximately 10,000 to 12,000 boxes of holly are shipped annually. Surveys made in the last few years in Delaware indicated that holly products valued at from \$170,000 to \$400,000 were shipped annually from this State and that about \$100,000 was received by those, mostly farmers, who gathered sprays and made up wreaths.⁷ Annual shipments were estimated at 7,000 to 16,000 cases containing in an average year some 1,500,000 to 2,000,000 wreaths and loose sprays or branches.

American holly wreaths are usually 10, 12, 14, 16, and 24, or even 36 inches in diameter. The 10- to 14-inch wreaths are the most common. The wreath framework is comprised of wires or withes of various hardwood species formed into a hoop of appropriate diameter, with the holly sprays bound to it. Bulk holly usually

⁶ Information on the holly industry on the Eastern Shore was furnished by K. J. Deigworth and Nelson H. Fritz, past and present district foresters, respectively, of the Maryland State Department of Forestry at Salisbury, Md.

⁷ Report of the Commission for the Conservation of Forests in Delaware to the Delaware General Assembly of 1927, and the annual reports of the State Forester to the Delaware State Forestry Commission, 1935 and 1936.

consists of sprays 2 to 3 feet long. Wreaths and bulk holly are usually shipped in standard holly boxes, 2 feet square on the ends and 4 feet long, built of thin lumber or with slats along the sides. A few paper cartons are now being used.

Recently more and more wreaths have been given treatment that preserves them so that they can be used over and over for several successive seasons. Fresh wreaths are put into boiling water, then are removed and subjected to a steam bath which softens and curls



FIGURE 9.—Harvesting wild American holly, Sussex County, Del. (Courtesy Delaware State Forestry Commission.)

the leaves. Each wreath is then dried and sprayed with green lacquer paint. Lastly, artificial berries are attached.

Because many inquiries as to the prices paid for holly greens have been received, it seemed desirable to include information on this point. It should be emphasized, however, that prices quoted for given years and places are not necessarily applicable in other years and to other localities. In 1926 persons in Delaware who made wreaths at home and sold them in small lots on the open market are said to have received 5 to 20 cents apiece for them. In Maryland,

during 1930 and 1931, local retailers paid approximately 15, 25, and 55 cents for 10-, 14-, and 24-inch wreaths, respectively. In 1938 and 1939 they received about 35 cents for the 16-inch wreath while paying the wreath maker 6 cents early in the season to about 18 cents by mid-December per wreath. Practically all good wreaths made up in Maryland were bought by dealers and others in those years.

Bulk holly in the standard-size boxes, although the quantity sold has considerably increased (1936-39), decreased in price (most of it is reported to be cut by vandals) and in 1939 brought pickers from 50 cents to \$1.40 per box instead of the \$2 per box prevailing in 1930 and 1931. The boxes themselves cost from 50 to 75 cents each. Under normal conditions the poor grades of English holly sprays brought growers in the Northwest 15 to 20 cents a pound. The better grades brought 30 to 35 cents a pound. The 1-pound holly gift packages which sold for as much as 50 to 60 cents each in 1930 to 1932 now bring \$1. A 16-inch wreath of English holly has been bringing as much as \$1.50 in New York City.

In order to conserve holly and bring growers better prices, the Maryland State Department of Forestry has started a cooperative project. Holly properly cut and graded is certified by the department and is packed in three sizes of containers, of which the largest (2×2×2 feet) is one-half standard-crate size. The department has been able to pay growers as much as \$6 per crate measure for this holly, which is several times the amount they have currently received through the normal trade channels.

SHIPMENT OF HOLLY^{*}

The standard boxes for the shipment of American holly are lined with newspaper and packed with wreaths or bulk holly. The usual number of wreaths is 17 dozen per box, which means that they are packed very tightly. A box when packed will weigh from 110 to 125 pounds. Wreaths with natural berries are packed in different boxes from those with artificial berries.

Packages commonly used for sprays in the Northwest are of two sizes. One contains 10 pounds of holly net, and the other 1 pound gross. The former is used for bulk shipment and the latter for gift packages. Gift packages are lined with colored wax papers. Wreaths are packed in cartons.

The shipping season in the East may begin as early as November 20 for the most distant points, to which shipments are made by freight. Express shipments begin about December 1 and cease about December 20 with shipments to near-by points. A considerable amount of holly is also moved by truck. Freight shipments often move in carload lots, one car holding approximately 166 cases.

Often, instead of showing the desired fresh, green condition upon arrival at its destination, holly shipped in boxes shows a bronze-green, brown, or blackish discoloration of the leaves that markedly

^{*} For further information of value to those contemplating the commercial shipment of holly branches or wreaths see Department of Agriculture Circular 207, The Deterioration of Christmas Holly in Transit and Storage.

reduces its salability. Investigations by representatives of the Department of Agriculture indicate that:

(1) Freezing or harvesting and shipping holly in a frozen state, does not directly cause discoloration of the leaves.

(2) Holly stored at 32° to 40° F. suffers little discoloration, while at 50° and more it discolors proportionately as temperatures are increased.

(3) Berries do not discolor except when mechanically injured.

(4) Holly superficially wet discolors more when stored at temperatures of 50° F. or higher than does dry holly.

(5) In warm "muggy" weather boxes of holly tend to heat and discoloration is likely to result, hence at such times wreaths should not be packed in boxes too far ahead of shipping schedule unless the inside temperature of the boxes can be kept at least as low as 40° F.

It is mentioned under Harvesting that holly sprays should be superficially dry before shipment. Dry, frozen sprays of holly in shipping boxes will condense moisture from the atmosphere when the boxes are exposed to warm moist air. Since dampness favors deterioration, it is as important to prevent moisture condensation as it is to make sure that sprays are superficially dry before they are packed.

MARKETING HOLLY

Producers and growers of holly would do well to make all arrangements for marketing their product before they begin harvesting. Such arrangements should include details as to (1) time and place of delivery, (2) the basis and time for payment, (3) the size and kind of sprays most desired by the buyer, and (4) the total quantity.

Many growers roughly grade their holly. The better holly sprays are those 6 inches or more in length with a goodly number of berries and leaves that are healthy and of a good color. The second class or grade includes shorter sprays, with or without berries, with leaves that are less attractive. The second grade is used for wreaths, together with a few berried sprays of the better grade. Wreaths, therefore, offer an outlet for male sprays and others that are not of the very best quality.

The possible markets for holly are numerous. Many growers can dispose of holly locally to wholesale grocers, florists, merchants at public markets, and persons who conduct open-air stands for the sale of Christmas trees just before the holidays. If local requirements have already been filled, similar agencies in other cities and States should be tried. In many sections making holly Christmas wreaths is a business. Holly can sometimes be sold to those who make wreaths, or, where safe shipping conditions are assured, the grower can himself undertake to make wreaths and market his holly in that form, through the channels mentioned above.

In recent years a large number of small potted conifers have been sold as "living Christmas trees." It seems probable that the sale of small potted holly trees would be as successful, or even more so. The English holly has a marvelously rich foliage and small potted plants of it would lend much charm to any home at Christmas.

Artificial holly berries are on the market at the present time. While it is not recommended that these be used in preference to live

berries, the artificial berries can be attached to male holly sprays, plants, and wreaths, greatly improving their attractiveness and making them more marketable. They retain their bright color, whereas natural berries of American holly have a tendency to discolor or become brown or black under some conditions.

The life of the holly trees can be measured in centuries. Although the owner of a plantation may have to wait 12 to 20 years after its establishment before he receives an income from it he finally achieves a practically permanent asset.

OTHER HOLLIES AND HOLLY-LIKE PLANTS

According to Standardized Plant Names, 12 additional species of true holly (*Ilex*), 11 varieties (9 of which are varieties of the English holly), and 1 hybrid holly are commonly recognized horticulturally. These are: Chinese holly, *Ilex cornuta*; common winterberry, *I. verticillata*; coral holly, *I. corallina*; dahoon, *I. cassine*; finetooth holly, *I. serrata*; Golden Queen holly, *I. aquifolium aureo-regina*; hedgehog holly, *I. aquifolium ferox*; Hodginson holly, *I. aquifolium hodginsoni*; inkberry, *I. glabra*; Japanese holly, *I. crenata*; laurel holly, *I. aquifolium laurifolia*; littleleaf holly, *I. aquifolium microphylla*; littleleaf Japanese holly, *I. crenata microphylla*; longstalk holly, *I. pendunculosa*; mountain winterberry, *I. montana*; possumhaw, *I. decidua*; pyramid holly, *I. aquifolium pyramidalis*; sawtooth holly, *I. aquifolium serratifolia*; smooth winterberry, *I. laevigata*; Topel holly, *I. vomitoria* × *opaca*; variegated English holly, horticultural variety of *I. aquifolium*; weeping holly, *I. aquifolium pendula*; yaupon (cassena), *I. vomitoria*; yellow winterberry, *I. laevigata herveyi*.

Dallimore, in *Arboretum Notes: The Hollies, or Species of Ilex*, in the *Quarterly Journal of Forestry* for April, 1926, describes in some detail 13 species of *Ilex*, and 7 probable hybrids, and lists more than 50 varieties of *Ilex aquifolium*. The varieties are grouped according to whether they have normal green leaves, green deformed leaves, or golden or silver leaves.

Other species of plants which are often locally referred to as holly are: Christmasberry or toyon (*Photinia salicifolia*, syn. *Heteromeles arbutifolia*), Oregon hollygrape (*Odostemon aquifolium*, syn. *Berberis aquifolium*), seaholly (*Eryngium maritimum*), desertholly (*Atriplex hymenelytra*), and mountain-holly (*Nemopanthus mucronatus*).

The Christmasberry, or toyon, which grows abundantly on the wild lands of the foothill region in California, is harvested in large quantities at Christmas time. It is sometimes called holly. Its evergreen foliage and bright red (sometimes yellowish) persistent fruit make it almost as decorative as holly, in place of which it is often used. Destructive harvesting and fires may some time decrease its abundance to such an extent that it will pay to protect from fire and furnish cultural treatment (such as thinnings) to areas containing Christmasberry. Just at present it is doubtful whether cultivation of Christmasberry would result in profit unless such cultivation produced a superior quality that would command a better price than does the wild stock.

